March 26, 1957 E. R. CORNEIL 2,786,656

IMPACT SPRAYING OF SLURRIES

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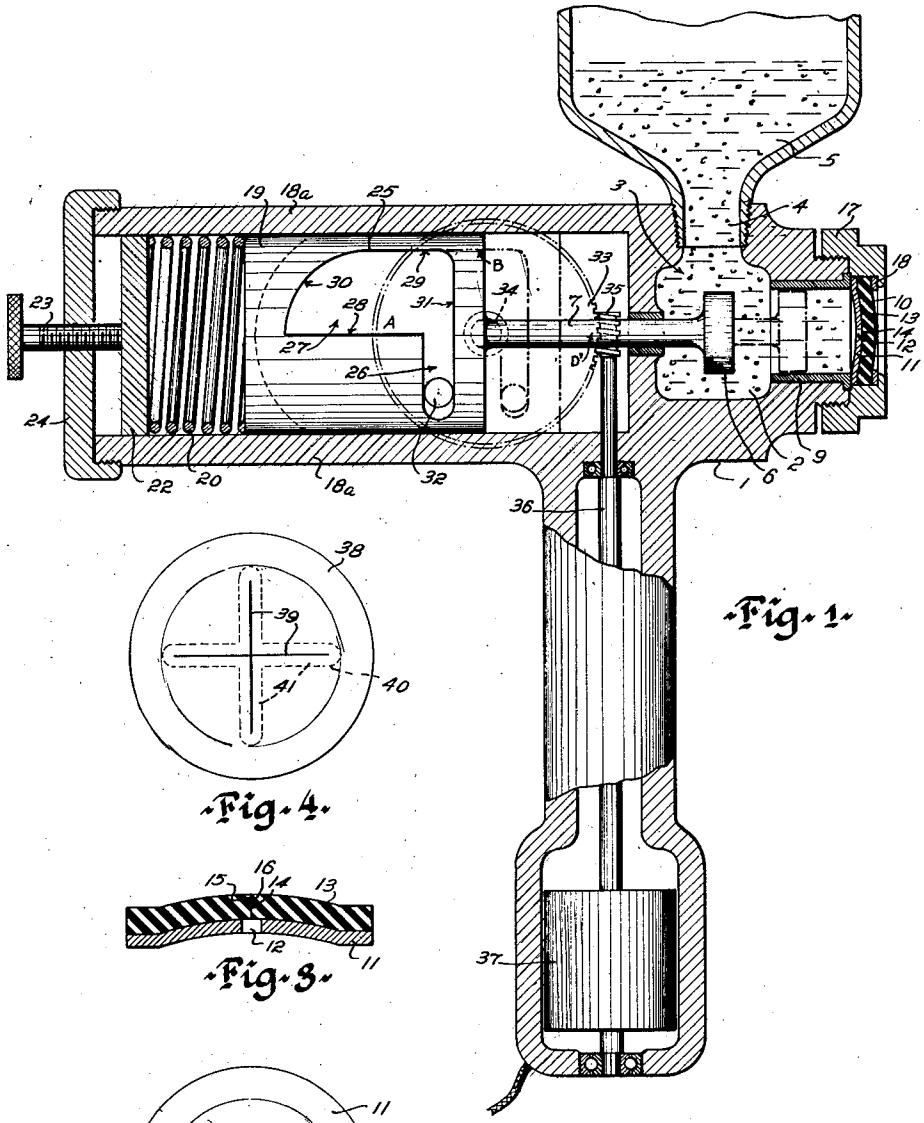


Fig. 1.

Fig. 4.

Fig. 3.

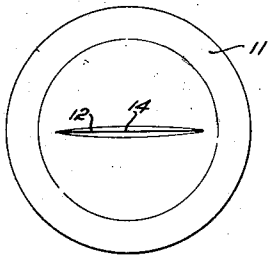


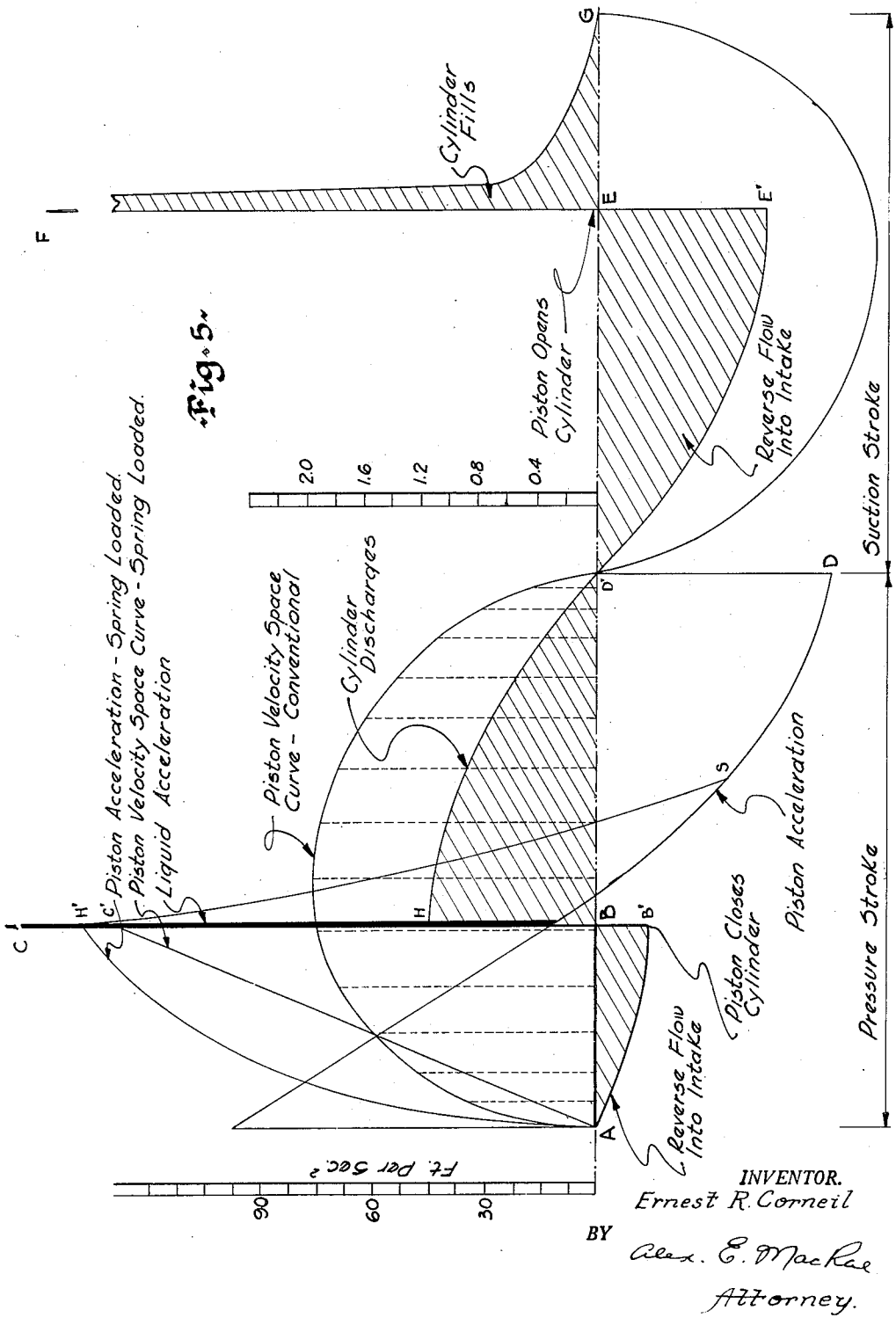
Fig. 2.

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IMPACT SPRAYING OF SLURRIES

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3 Claims. (Cl. 259—151)

This invention relates to a means for spraying and more particularly for spraying slurries of coarse particles of a pigment in a liquid carrier.

Heretofore there has been no satisfactory way to spray a slurry containing massive pigment particles onto a surface and obtain a uniform coating. Difficulty is encountered because of the natural tendency of the particles to settle out of suspension, thus clogging equipment and resulting in a non-uniform coating. Thus pigment particle size constitutes a limitation in the use of prior spraying equipment.

Further, in order to maintain continuous flow and a uniform spray of suspended pigments in a liquid carrier, low viscosity carriers are used containing volatiles which are lost by evaporation, on drying. These vapours create an unpleasant atmosphere and a danger of fire and explosion.

Another object is to provide an efficient, easily cleaned, inexpensive sprayer for applying coatings of coarse pigment particles in non-volatile liquid carriers.

A further object is to provide a device for spraying a slurry of massive particles of solid materials in a liquid carrier which agitates into homogeneity and then discharges successive increments of such slurry.

The invention will be described with reference to the accompanying drawings, in which:

Figure 1 is a sectional elevation of one embodiment of the invention,

Figure 2 is a plan view of one form of nozzle,

Figure 3 is a section through the nozzle of Figure 2,

Figure 4 is a plan view of another form of nozzle, and

Figure 5 is a space diagram indicating acceleration and velocity variation with time.

Referring to Figure 1, 1 is a body member having a mixing chamber 2 therein arranged to receive slurry 3 through intake 4 from a supply tank 5. A piston 6 is disposed in chamber 2 and is carried by rod 7 reciprocally mounted in the wall of the chamber. Axially aligned with piston 6 is a cylinder 9 also mounted in the wall of chamber 2. The cylinder 9 has an open inner end to reciprocally receive the piston 6 in sliding fit engagement therewith and its outer end is provided with a nozzle structure 10. The nozzle structure 10 comprises an inner rigid disc or support plate 11, slightly dished as shown, engaging the outer end of cylinder 9 and having an elongated centrally disposed slot 12 therein. A disc 13, part or all of which is formed of flexible material, such as rubber, rubber fabric, or plastic composition, overlies, has a slit 14 therein overlying slot 12 and substantially coextensive therewith. The slit 14 provides complementary resilient lips 15 and 16 in normally closed relation due to the inherent resiliency of the flexible disc 13. A ring clamp 17, in screw-threaded engagement with the body member 1, retains the discs 11 and 13 in position on the outer end of the cylinder 9, a sealing ring 18 being interposed between the clamp 17 and disc 13. It will be apparent that the clamp 17 is readily removable, as by means of a wrench or the like, for removal of discs 11 and 13 to permit cleaning of associated portions of the device.

Means for imparting rapid pressure strokes and alternate return strokes to the piston comprises a crosshead 19 slidingly mounted in guide 18*a* which may be integral with body member 1. The end of piston rod 7 is fixed to one end of the crosshead, the other end of which is engaged by one end of a coil spring 29 also supported in guide 18*a*. The other end of spring 20 bears against a plate 22 which is longitudinally adjustable with respect to guide 18*a* as by means of a screw 23. The screw 23 may be carried by a removable cover plate 24.

The crosshead 19 is provided with a cam slot 25 having a portion 26 of restricted uniform width extending right angularly to guide 18*a* and piston rod 7. The slot 25 also has a portion 27 of greater width, one wall 28 of which extends in substantial axial alignment with piston rod 7. Portion 27 also has a wall 29 parallel to wall 28 and joined thereto by a quarter circular or arcuate wall 30, and a wall 31 forming a continuation of one wall of portion 26.

Cam slot 25 is engaged by a follower pin 32 eccentrically carried by a gear wheel 33 mounted on a shaft 34. Gear wheel 33 is arranged to be constantly driven as by means of a worm gear 35 carried by a shaft 36 rotated by a motor 37.

In operation, it will be apparent that a compressive or cocking action on spring 22 will be effected in response to rotation of gear wheel 33 from point D' to point A, during which movement follower pin 32 will traverse portion 26 of the cam slot to move crosshead 19 against the spring and cause such cocking action. At point A, pin 32 is suddenly released from slot portion 26 to permit a rapid pressure stroke of the piston under the action of spring 22 and crosshead 19. Following such stroke, pin 32 traverses the enlarged portion 27 of the cam slot.

The operation of the mechanism described is diagrammatically represented in Figure 5 which is scaled for a piston with a 1¼" overall stroke, a ¾" effective stroke and a ⅝" diameter cylinder.

Pigments such as sawdust, corkgranules, vermiculite, flock, chaff and sand, may be mixed with a carrier which need not be of the normal low viscosity type. The size of the pigment particles need be only small enough so that upon rather violent agitation a homogeneous slurry is formed. The supply tank 5 is charged with a mixture of pigment and carrier which flows through intake 4 into mixing chamber 2. Mixing of this slurry is accomplished in two ways. The motion of the piston within the chamber causes agitation of the mixture and also as indicated in Figure 5, in the cross-hatched area EFG, the piston action causes rather violent reverse flow from the mixing chamber into the cylinder, agitating the mixture further just before discharge.

When follower pin 32 rotates into position A, as indicated in Figures 1 and 5, the spring 20, which has been cocked during the reverse or suction stroke of the piston, is released and the crosshead 19 and the piston are moved ahead rapidly. The increasing volume of piston rod within the mixing chamber displaces some of the slurry, as indicated by area AB'B. At B, the piston enters the cylinder and imparts a velocity BC' to the increment of slurry within the cylinder opening, the resilient nozzle lips 15 and 16 and discharging the increment from the cylinder area BHD'. When the follower pin 32 reaches point D' the velocity of the piston is zero and the nozzle lips close. The suction stroke of the piston begins and the slurry behind the piston is pushed out into the mixing chamber area D'E'E. At E, the piston leaves the cylinder and slurry rushes violently into the cylinder, as indicated by area EFG, because of the low pressure left by the piston movement in the closed cylinder chamber.

Throughout the suction stroke D'G the spring **20** was being cocked and the cycle repeats.

By way of comparison, Figure 5 shows a piston velocity space curve for a spring loaded piston and for a simple reciprocating piston.

With reference to the piston acceleration curve, at point A just after release of spring **20**, the acceleration is a maximum. This acceleration decreases linearly due to the force of resistance offered by the slurry on the piston head until the follower pin **32** reaches a point between B and D' where it engages the crosshead 19 and exerts a force transmitted to the piston which slows the rate of decrease of acceleration of the piston, as shown by line H'S, caused by the force of the slurry on the piston head. At point D' the piston is instantaneously stationary and thus has no acceleration.

Referring to the liquid acceleration curve, when the follower pin **32** reaches point B, the piston enters the cylinder and the velocity BC is immediately imparted to the increment of slurry in the cylinder. The liquid acceleration curve runs from zero at B to a very high value, represented at C, then almost immediately back to the piston acceleration curve at H'. The value of C is approximately proportional to the mass of the reciprocating assembly. The piston **6**, piston rod **7** and crosshead **19** provide a large mass which, being accelerated by the spring, exerts a force which imparts a high acceleration to the increment of slurry within the cylinder.

The piston acceleration-spring loaded curve is directly applicable to the conventional pump. Since in the conventional pump the fluid acceleration is greatest when the velocity is a minimum, and there is no acceleration when the velocity is greatest, a very lazy discharge is effected. This is clarified by considering the relationship $F=Ma$. At the time when the velocity is greatest and thus the mass is greatest, there is no acceleration and thus no force and no impact. Further, in the conventional pump the velocity of the liquid into or out of the cylinder starts at a minimum and builds up to a maximum then drops off to zero gradually. The slow starting velocity permits separation in the slurry giving a non-uniform coating.

In the present invention the maximum acceleration BH' occurs at the same time as the maximum velocity BC' giving a very high impact to the slurry against the nozzle, causing the resilient nozzle lips to open and the uniform slurry to be discharged at a high velocity. The slurry is discharged immediately after a period of extreme agitation that is through about 120° of rotation from E to B, thus ejecting a homogeneous mixture which will form a uniform coating of consistent composition.

Figure 4 shows a second form of nozzle structure. Two pairs of lips **39** are arranged in a flexible disc **38** in a right angled intersecting relation. The support plate **40** has corresponding slots **41**. The disc 38 and plate **40** may be moulded together as a substantially integral part. It will be recognized that any number of slots radiating from a common center or otherwise can be used to give different patterns to the material being ejected. Any quick acting mechanism which is opened in response to pressures from within the cylinder is construed to fulfill the requirements for the nozzle of the present invention.

What I claim is:

1. A device for spraying a slurry of massive particles of solid material in a liquid carrier comprising a piston, a mixing chamber for said slurry reciprocally receiving said piston to cause agitation of said slurry, a cylinder having an open end communicating with said chamber and arranged to reciprocally receive said piston, said mixing chamber having an intake for said slurry, a pressure-operable nozzle normally closing the other end of said cylinder, means for loading said piston to impart a pressure stroke in one direction thereto, comprising a spring exerting pressure on the piston in said one direction, and means for compressing said spring to cock the same, and means for releasing said compressing means, said pressure stroke causing entry of said piston into said cylinder, said nozzle being openable by force transmitted to the slurry in the cylinder by the piston in response to said pressure stroke, and means for imparting to the piston a suction stroke in the opposite direction to effect closure of said nozzle and an inrush of slurry from the mixing chamber into said cylinder.

2. A device for spraying a slurry of massive particles of solid material in a liquid carrier comprising a piston, a mixing chamber for said slurry reciprocally receiving said piston to cause agitation of said slurry, a cylinder having an open end communicating with said chamber and arranged to reciprocally receive said piston, said mixing chamber having an intake for said slurry, a pressure-operable nozzle normally closing the other end of said cylinder, means for loading said piston to impart a pressure stroke in one direction thereto, comprising a piston rod carrying the piston, a member fixed to said rod, a guide slidably supporting said member, a spring bearing on said member to urge the piston in said one direction, said member having a cam slot therein, a wheel having a cam follower pin extending into said slot, means for continuously rotating said wheel, said slot having a narrow portion extending right angularly to the axis of said rod, and a wide portion extending parallel to the axis of said rod, said pressure stroke causing entry of said piston into said cylinder, said nozzle being openable by force transmitted to the slurry in the cylinder by the piston in response to said pressure stroke, and means for imparting to the piston a suction stroke in the opposite direction to effect closure of said nozzle and an inrush of slurry from the mixing chamber into said cylinder.

3. A device for spraying a slurry of coarse particles of solid material in a liquid carrier comprising a piston, a mixing chamber for said slurry reciprocally receiving said piston to cause agitation of said slurry, a cylinder having an open end communicating with said chamber and arranged to reciprocally receive said piston, said mixing chamber having an intake for said slurry, a pressure-operable nozzle normally closing the other end of said cylinder, pressure means acting on the piston to impart a rapid pressure stroke thereto, the movement of said piston during said pressure stroke being from within the mixing chamber to within said cylinder to cause agitation of the slurry in said chamber and propulsion of the slurry through said cylinder and nozzle, means for moving said piston in the opposite direction against the action of said pressure means to effect a suction stroke thereof in reverse extent to said pressure stroke, said suction stroke causing agitation of the slurry in said chamber and cylinder, and power means for successively and continuously actuating said pressure means and piston moving means to cause successive pressure and suction strokes of the piston.

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